Customer No.: 31561
Application No.: 10/708,229
Docket No.: 7804-US-PA

AMENDMENTS

To the Specification:

Please amend paragraph [0003] as follows:

[0003] This invention generally relates to a drive device for a thin film transistor ("TFT") liquid crystal display ("LCD"), and more particularly to a line inversion drive device for a ~~thin film transister liquid crystal display~~ TFT-LCD.

Please amended paragraph [0005] as follows:

[0005] Cathode ray tube ("CRT") display products have dominated the display markets for a long time because of their good image quality and cheaper price. However, the CRT display products consume more power and take more space than LCD ~~display~~ products.

Please amended paragraph [0006] as follows:

[0006] ~~LCD display has~~ The LCDs have been used in electronic calculators and watches [[in]] since the 1970s. As the technology ~~advanees~~ advanced, [[it]] the LCDs [[has]] have been widely used in electronic products (such as portable TVs, videophones, laptop computers, desktop PC display and projective TVs) because of [[its]] their superior image quality, low power consumption, low-voltage driven feature, and smaller size. The display markets are trending toward the LCD ~~display~~ products rather than the CRT [[LCD]] display products.

Please amended paragraph [0007] as follows:

[0007] Most ~~TFT-LCD~~ TFT-LCDs ~~displays~~ adopt a line inversion drive structure. FIG. 1 is a block diagram of a conventional line inversion drive device. [[Data]] A data drive device 110 includes a Gamma compensation circuit 102 and an inversion circuit 104. The Gamma compensation circuit 102 sends its outputs to the inversion circuit 104. ~~LCD display's~~ An LCD's clock control circuit 106 is coupled to a switch circuit 108 and the data drive device 110. ~~Switch~~ The switch circuit 108 sends its outputs to the Gamma compensation circuit 102. Data is fed into the data drive device 110 for Gamma compensation first and then for inversion. [[Data]] The data drive device 110 is coupled to [[a]] an LCD ~~display~~ 112 and outputs signals to control the LCD ~~display~~ 112.

Please amended paragraph [0008] as follows:

[0008] The conventional line inversion drive device uses the Gamma compensation circuit 102 to compensate the input data signals. This is because the input data signals are symmetrical signals, i.e., the voltage differences between each signal are the same, but the ~~reference voltages~~ voltage differences ~~(Vref1(+), Vref2(+), Vref3(+), Vref4(+), and Vref5(+))~~ ($\triangle V_1$ or $\triangle V_6$、$\triangle V_2$ or $\triangle V_5$、$\triangle V_3$ or $\triangle V_4$、$\triangle V_4$ or $\triangle V_3$、$\triangle V_5$ or $\triangle V_2$、$\triangle V_6$ or $\triangle V_1$) are not symmetrical as shown in FIG. 2. FIG. 2 is an aperture rate-voltage curve for ~~LCD displays~~ LCDs. The aperture rate of the LCD ~~display~~ depends

on the voltage applied to the LCD ~~display~~. To display the difference of color and brightness, the voltage differences between reference voltages are not the same, i.e., not symmetrical. Hence, Gamma compensation is required to compensate the input data signals to match the level of the reference voltages.

Please amended paragraph [0009] as follows:

[0009] Because the line inversion drive structure requires opposite polarity in every alternative line (e.g., lines 1, 3, 5 . . . are positive; lines 2, 4, 6 . . . are negative), two groups of reference voltages are required as shown in FIGs. 3a and 3b. This is because although the voltage differences ΔV_1, ΔV_2, ΔV_3, ΔV_4, ΔV_5, [[and ΔV_6]] and ΔV_6 are the same, after line inversion, Vref1(+) ≠ Vref5(-) , Vref2(+) ≠ Vref4(-), Vref3(+) ≠ Vref3(-), Vref4(+) ≠ Vref2(-), and Vref5(+) ≠ Vref4(-). Hence, two groups of the reference voltages are required for opposite polarities and the inversion circuit 104 is also required to inverse the polarity of the input data signals.

Please amended paragraph [0010] as follows:

[0010] Then the ~~LCD display's~~ LCD's clock control circuit 106 controls the inversion circuit 104 to output the compensated input data signals with positive and negative polarities alternatively to the data drive device 110. The clock control circuit 106 also controls the switch circuit to output those two groups of the reference voltages to the data drive device 110 alternatively corresponding to the input data signals with positive and negative polarities respectively. [[Data]] The data drive device 110

commands the LCD ~~display~~ 112 ~~displays~~ to display the color and brightness corresponding to the input data signals.

Please amended paragraph [0011] as follows:

[0011] Hence, the conventional line inversion drive structure requires double reference voltage levels for the LCD ~~display~~ compared to a non-inversion drive structure. For example, when the LCD ~~display~~ requires 5 reference voltage levels, the conventional line inversion drive structure requires 10 reference voltage levels. This increases circuit complexity and device costs.

Please amended paragraph [0012] as follows:

[0012] ~~An object of the~~ The present invention is directed to ~~provide~~ a line inversion drive device for a TFT-LCD ~~display~~ to improve the drawbacks of the conventional line inversion drive structure.

Please amended paragraph [0013] as follows:

[0013] The present invention provides a line inversion drive device for a TFT-LCD ~~display~~. The line inversion drive device, embedded in a clock controller, includes a data inversion circuit for receiving a data signal; the data inversion circuit determines whether to invert the data signal responsive to an inversion control signal and then ~~output~~ outputs a display signal.

Please amended paragraph [0014] as follows:

[0014] The present invention also provides a line inversion drive circuit for a ~~thin film transistor liquid crystal display~~ TFT-LCD. The line inversion drive circuit comprises a clock controller and a data line driver. The clock controller includes a data inversion circuit for receiving a data signal and a clock control device; the data inversion circuit is coupled to the clock control device; the data inversion circuit which is responsive to an inversion control signal determines whether to invert the data signal and outputs a display signal. The data line driver, coupled to the data inversion device, is for receiving a group of reference voltages; the data line driver is responsive to the group of reference voltages and the display signal drives a plurality of data lines of the ~~thin film transistor liquid crystal display~~ TFT-LCD. The data inversion circuit further comprises a Gamma compensation circuit coupled to the data inversion circuit to compensate the display signal.

Please amended paragraph [0018] as follows:

[0018] FIG. 2 is an aperture rate-voltage curve for ~~LCD displays~~ LCDs.

Please amended paragraph [0021] as follows:

[0021] FIG. 4 is an aperture rate-voltage curve for transmission-type ~~LCD displays~~ LCDs.

Please amended paragraph [0024] as follows:

[0024] The line inversion drive device in accordance with the present invention can apply to a transmission-type LCD ~~display~~. FIG. 4 is an aperture rate-voltage curve for the transmission-type ~~LCD displays~~ LCDs. The voltage differences between $\triangle V_1$ and $\triangle V_2$, $\triangle V_3$ and $\triangle V_4$, and $\triangle V_5$ and $\triangle V_6$ are almost the same. Hence, the present invention can invert the input data signal first and then ~~performs~~ perform Gamma compensation. The output displayed by the LCD ~~display~~ is substantially the same as the output of the conventional line inversion drive device. But the present invention reduces the numbers of reference voltage levels by half. Therefore, the entire circuit design is simpler and cheaper. But it should be noted that the resistors of the Gamma compensation circuit have to be set symmetrically, and the display [[have]] has to be the transmission-type LCD ~~display~~.

Please amended paragraph [0025] as follows:

[0025] FIG. 5 is a block diagram of a preferred embodiment of a line inversion drive device in accordance with the present invention. Referring to FIG. 5, the line inversion drive device in accordance with the present invention, coupled to a LCD ~~display~~, comprises a clock control circuit 602 and a data drive device 604. [[Clock]] The clock control circuit 602 inverts the polarity of the input data signal and then outputs a display signal. The clock control circuit 602 outputs the input data signal and the inverse input data signal alternatively as the display signal. The data drive device 604 is coupled to the data inversion circuit 606 and the LCD ~~display~~ 612 for receiving the reference voltages. The data drive device 604, responsive to the display signal and the reference

voltages, drives the LCD ~~display~~ 612.

Please amended paragraph [0026] as follows:

[0026] Furthermore, the clock control circuit 602 includes the data inversion circuit 606 and the LCD ~~display~~ clock controller 608. The data inversion circuit 606 inverts the polarity of the input data signal and outputs the input data signal and the inverse input data signal alternatively. The LCD ~~display~~ clock controller 608 is coupled to the data inversion circuit 606 to make the data inversion circuit 606 ~~output~~ outputs the input data signal and the inverse input data signal alternatively.

Please amended paragraph [0028] as follows:

[0028] The line inversion drive device in accordance with the present invention works as follows. First, the data inversion circuit 606 receives the input data signal, and the data drive device receives the reference voltages. The data inversion circuit 606 inverts the polarity of the input data signal. Then [[The]] the LCD ~~display~~ clock controller 608 controls the data inversion circuit 606 to output the input data signal and the inverse input data signal alternatively as the display signal to the Gamma compensation circuit 610. The Gamma compensation circuit 610 compensates the display signal. Then the data drive device 604 determines the reference voltage levels between which the display signal is located thereby, making the LCD ~~display~~ 612 display the corresponding color and brightness.

Please amended paragraph [0029] as follows:

[0029] FIG. 6 is a flow chart of a preferred embodiment of a line inversion drive method in accordance with the present invention. The line inversion drive method for a ~~thin film transistor liquid crystal display~~ TFT-LCD is to drive a plurality of data lines. First step (S100) is to receive a data signal and a group of reference voltages. Those reference voltages are always supplied to the ~~LCD display's~~ LCD's data line driver. Later step (S102) is to determine whether to invert the data signal responsive to an inversion control signal. If the data signal is required to be inverted, the data signal is inverted and then outputted to the data line driver as a display signal; if the data signal is not required to be inverted, [[then]] the data signal is then outputted to the data line driver directly as a display signal. Then the display signal is compensated (S104). For example, the display signal is compensated by Gamma compensation. Final step (S106) is [[to]] for driving the plurality of the data lines responsive to the compensated display signal and the group of the reference voltages.

Please amended paragraph [0031] as follows:

[0031] Portable products also benefit from the present invention. For example, most existing PDAs are using the conventional line inversion drive structures and thus require an additional IC for switching 2 groups of reference voltages. The present invention does not require this additional IC because there is only a single group of reference voltages.